Detection and Mapping of Methane and Water on Mars: Evidence for Intense Local Enhancements in Methane

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We detected methane and water on Mars using state-of-the-art infrared spectrometers at the NASA IRTF (Mauna Kea, HI) and Gemini South (Cerro Pachon, Chile). These instruments provide high angular resolution along with high spectral resolving power, permitting a simultaneous search for methane and water at each point along the

spectrometer entrance slit. The dates sampled cover both blue and red geocentric Doppler shifts, and the detected lines shift in the expected fashion. The retrieved water burdens and their variation with latitude agree well with independent spacecraft data taken at the same time. Methane shows pronounced enhancements over several equatorial regions, consistent with enhanced local release. Details will be presented for several longitude ranges.

The presence of significant methane on Mars requires recent release from sub-surface reservoirs; the detection of strong latitudinal gradients requires that a rapid destruction mechanism be operating. The lifetime against destruction cannot be much longer than equator-to-pole transport times imposed by the Hadley circulation (weeks), and must certainly be far shorter than the photochemical lifetime (~300 years). Heterogenous reactions with oxidants adsorbed on airborne aerosol grains are a possible explanation. The present methane release rate (inferred from its atmospheric abundance) provides an important quantitative constraint for assessing biogenic vs. primordial or geothermal origins. Additional chemical tests can help to constrain these possibilities, but measurement of isotopic variations with sufficient accuracy to test origins will likely require investigations from space.

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